WooKong Multi-Rotor

User Manual

V 3.1

www.dji-innovations.com

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Warning & Disclaimer

WKM is an excellent autopilot system offering tremendous flight features for low altitude multi rotor working in restricted space compared to normal helicopter. It is not a toy when installed in multi rotors of any size. Please respect the AMA's National Model Aircraft Safety Code. Despite our efforts in making the controller to operate in the safest manner when the main power battery is connected, such as: disabling MC signal to ESCs when USB is connected; disabling throttle input and stick command when throttle stick is not at the lowest position, we strongly recommend customers to remove all propellers, use power supply from R/C system or flight pack battery, and keep children away during firmware upgrade, system calibration and parameter setup. DJI Innovations assumes no liability for damage(s) or injuries incurred directly or indirectly from the use of this product. Please strictly follow these steps to mount and connect WooKong for Multi Rotor (WKM) system on your multi rotor, as well as to install the Assistant software on your computer.

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WKM Profile

DJI WooKong for multi-motors (WKM) is an autopilot system designed for serious multi-rotor enthusiasts providing excellent self-leveling and position holding, which completely takes the stress out of flying RC multi-rotors for both professional and hobby applications. WKM can be installed in a variety of models from quad-rotor to octo-rotor.

WKM Control Modes

	GPS Atti. Mode	Atti. Mode	Manual Mode
Command Stick Meaning	Multi attitude control; Stick center position for 0˚ attitude, its endpoint is 35˚.		Maximum angular velocity is 150 ?/s. No attitude angle limitation and vertical velocity locking.
Command Linearity	YES		
Stick Released	Lock rotor position when GPS signal is adequate.	Only attitude stabilizing.	NOT Recommend
Altitude Lock	Maintain the altitude best above 1 meter from ground.		NO
GPS Lost	After 10s when GPS signal lost, system enters **Atti. Mode** automatically.	Only performing attitude stabilizing without position lock.	---
Safety	Attitude & speed mixture control ensures stability; Enhanced fail-safe		Depends on experience.
Applications	AP work	Sports flying.	---

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In Box

Main Controller (MC) ×1

The Main Controller (MC) is the brain of the system, it communicates with the IMU, GPS/Compass , ESC and RC transmitter to carry out autopilot functionality. The Main Controller provides USB interface to configure MC and update firmware from a PC.

IMU ×1

The Inertial Measurement Unit (IMU) consists of one 3-axis accelerometer, one 3-axis gyroscope and a barometer. It is for sensing the attitude.

GPS & Compass ×1

The GPS/Compass module is for sensing the position and direction.

LED Indicator ×1

The LED indicates different states of system.

Power Management Unit (PMU) ×1

Specially designed for WKM to solve the high power consumption problem of power support system. It contains two power outputs for entire WKM system and receiver separately, a battery voltage monitor, and two CAN-Bus interfaces.

GPS Bracket ×1

Because the GPS & Compass are sensitive to magnetic interference, you should use this bracket to mount the GPS module.

PMU Connecter ×1

For connections among Battery, ESCs and PMU.

USB Cable ×1

This cable is used to configure MC and update firmware.

3-PIN Servo Cable ×10

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Cables used to connect the Main Controller to the RC receiver.

3M Gummed Paper ×4

For fixing WKM components on multi-rotor's frame.

Warranty Information Card ×1

It recommends the necessary conditions for using WKM system and related safety issues. Please fill out the customer & multi rotor information card and return to DJI Innovations to register your product warranty.

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Matters Need Attention

For safety reasons, please pay serious attention to all following items:

1. **Please disconnect ESCs and battery connector or remove all propellers during** firmware upgrade**, configuration and system setup !**
2. **Do not mount the IMU upside-down.**
3. **You have to reboot MC and redo the Tx calibration after you change RC system.**
4. **In Tx Calibration of assistant software:**
   - **Throttle: Slide left is craft down, slide right is craft up;**
   - **Rudder: Slide left is nose left, slide right is nose right;**
   - **Elevator: Slide left is craft back, slide right is craft front;**
   - **Aileron: Slide left is craft left, slide right is craft right.**
5. **GPS/Compass is sensitive to magnetic interference, should be far away from any electronic devices.**
6. **Make sure switch on the transmitter first, then power on multi-rotor before takeoff! Power off multi-rotor first, then switch off the transmitter after landing!**
7. **Do not fly in GPS Mode when the signal is not good (red light blinks)!**
8. **If you open the gimbal control in assistant software during the configuration, please note that there is output from F1 and F2 ports. Now you should not connect these ports to ESCs which is wired with propellers equipped motors.**
9. **Do NOT set the failed-safe position of throttle under 10% of endpoint.**
10. **Throttle stick position should always be higher than 10% from cut-throttle during the flight!**
11. **Low voltage protections are NOT fun! You should land your multi-rotor ASAP in any level of protection to prevent your multi-rotor from crash or other harmful consequences!**
12. **By using Immediately mode to stop motors, in any control mode, once motors start and throttle stick is over 10%, motors will stop immediately when throttle stick is back under 10% again. In this case, if you push the throttle stick over 10% in 5 seconds after motors stop, motors will re-start; Combination Stick Command (CSC) is no need. If you don't push throttle stick after motors start in three seconds, motors will stop automatically.**
13. **By using Intelligent mode to stop motors, motors will start or stop immediately when you execute CSC. During normal flight, only pull throttle stick under 10% will not stop motors in any control mode. You have to execute CSC to re-start motors if they stop during the flight.**
14. **When you set Mixer Type from Octo-rotor to Quad-rotor / Hexa rotor, the gimbal setting will automatically switch to off for safety, which may lead the gimbal to tilt to one side, please turn to the Gimbal section for reconfiguration.**

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Assembly

GPS/COMPASS

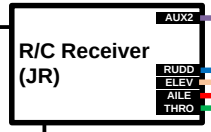
- GPS/Compass is sensitive to magnetic interference, should be far away from any electronic devices.
- You should use epoxy resin AB glue to assemble the GPS bracket first as the figure showed in previous page.
- Mount the bracket on the center plate of craft first, then fix the GPS on the plate of the bracket (by 3M glue provided). The GPS is sensitive to vibration interference, so position the bracket at least 10 cm from any rotor.
- The DJI logo marked on the GPS should face the sky, with the orientation arrow pointing directly forward. The GPS/Compass is packaged with a special indication line for mounting for the first time.
- If you are uncertain whether materials near the GPS/Compass module are magnetic or not, you can use a compass or magnet to check it. If you use your own mounting rod, make sure it is NOT magnetic!

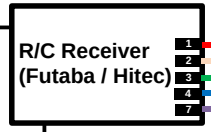
R/C System

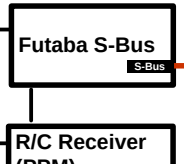
These are example connections. Please setup Aileron, Elevator, Throttle, Rudder channels on your Tx first, and choose one 2 or 3 positions switch/channel as control mode switch, then connect your receiver to the right ports on MC.

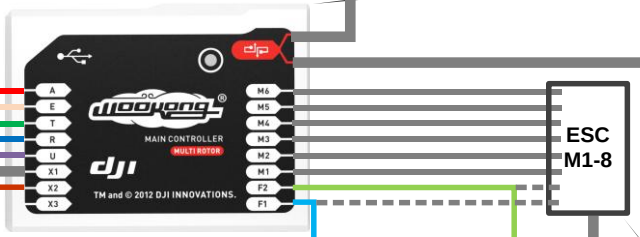
IMU

- The IMU is best positioned near the multi rotor's center of gravity, where vibration is relatively low.
- Orient the IMU such that the arrow marked on the printed surface of the IMU faces the sky and points directly forward, backward, left or right.
- The sides of the IMU should be precisely parallel to the multi rotor body. Use double-sided foam tape for secured installation.
- Check the double faced adhesive tape regularly to ensure that the IMU is securely positioned.
- DO NOT cover the ventilation holes, keep them unobstructed.
- The IMU module is NOT water-proof or oil-proof.
- Do not mount the IMU upside-down.





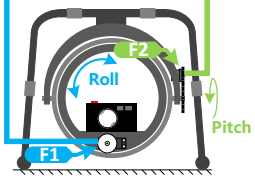




Main Controller

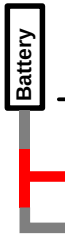
- There is no orientation requirement for the Main Controller. Choose a mounting location where as shorter ESC extension wires are needed as possible. Please make sure all ports are accessible when installing the MC so as to facilitate wiring and software configuration.
- In three-pin ports, pins near the nicks are signal pins.

- After choosing a location to mount the MC, it is recommended that you DO NOT mount the MC until all wirings and software configurations are completed.



PMU & Battery

- There is no requirement for PMU mounting.
- Use our PMU Connecter (red line depicts in figure) to connect battery, PMU and ESCs.
- For safety reason, please disconnect ESCs and battery connecter during the firmware upgrade and configuration procedure.
- You can choose 2S-6S LiPo battery.



LED Indicator

- Place the LED indicator at an appropriate location of craft body far away from the GPS. Do not mount it on other electronic devices.
- Make sure You can see the light during the flight.
- You can connect LED to the CAN-Bus port on GPS connection wire.

ESC & Motor

- Please make sure you are using the ESCs and motors recommended by the manufacturer of your multi rotor first. We recommend you use DJI motors and ESCs. WKM output is 400Hz refresh frequency.
- Connect all ESCs to MC by the motor numbering method introduced in our Assistant software.
- If you use 3rd party ESCs, please make sure the ESCs travel midpoint is at 1520us. DO NOT use 700us travel midpoint ESC, as it may lead aircraft to fly away or cause injury and damage. After connect ESCs, calibrate ESCs one by one through the receiver directly before connect them to your MC, Make sure program all of them into Governor off, Break off and Normal Start up to get best experience.
- If you use 3rd party ESCs, please cut the red wire (power wire) of your ESCs , as the power from V-SEN on PMU is suitable to most of receivers and other electronic devices.
- If you use extra BEC, please use a servo cable without power wire to connect V-SEN to X1. (Not recommend)

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Assistant Software

Software and Driver Installation

STEP1: Please download assistant software and driver from our website. If your operating system is 32bit, download 32bit driver; if your operating system is 64bit, download 64bit driver. Then decompress;

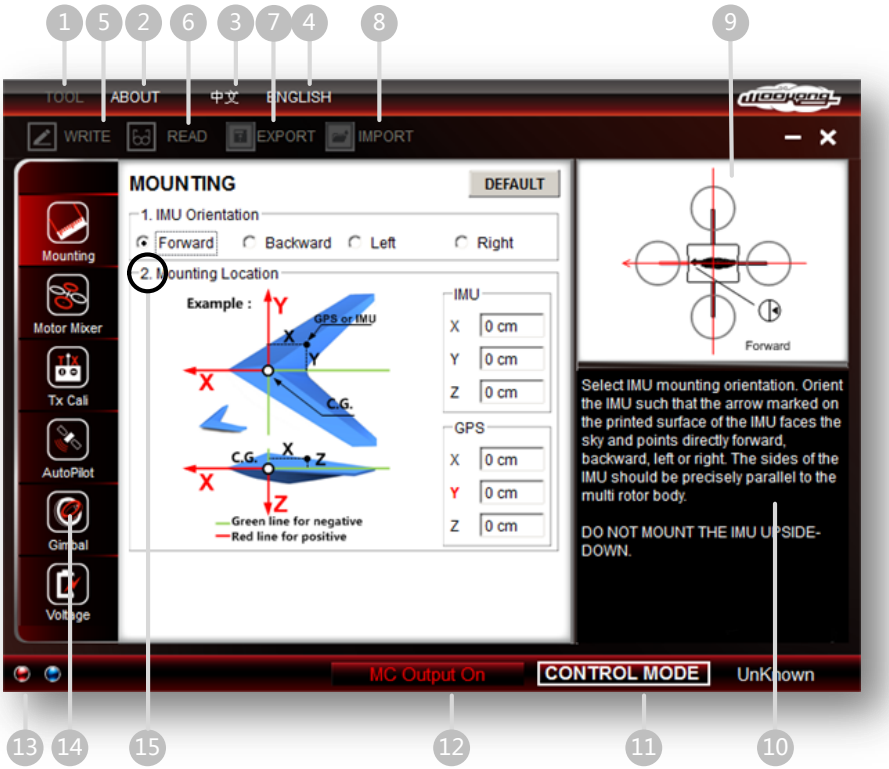
STEP2: Connect MC and PC via USB cable, power on MC;

STEP3: If operating system tries to install driver automatically, cancel it.

STEP4: Open folder DJI_Wookong_M_Driver_32bit or DJI_Wookong_Multi_Rotor_Driver_64bit, double click Driver Setup.bat file and follow the steps to finish installation.

STEP5: Open the assistant software folder, double click Setup.exe file and follow the steps to finish installation.

GUI



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1 TOOL

- ➔ Firmware upgrade: Update your firmware from DJI server, keep your WKM system up-to-date.
- ➔ Disable All Knob
- ➔ Check for Updates: Check out the latest versions of assistant software and firmware. If necessary, you can follow the links displayed to find the download page.

2 ABOUT

- ➔ Info: Information regarding your WKM.
- ➔ Error Code

3 中文: Chinese interface.

4 ENGLISH: English interface.

5 WRITE: Write data of the current page to your MC. The parameter or the title of which will turn red and bold when modified, make sure you click the Write button or press Enter to update your system. Optional parameters will be written to MC directly after modification.

6 READ: Read parameters from MC for current page.

7 EXPORT: Export configuration data.

8 IMPORT: Import version compatible configuration data.

9 Graphic guidance

10 Text guidance

11 CONTROL MODE: Control mode indication.

12 MC Output On: Indicates there are outputs to ESCs; when communication is built up between MC and assistant software via USB cable, MC Output Off appears, it indicates no output to motors, then you can configure your multi rotor with assistant software more safely!

13 Red light: WKM↔PC has been disconnected.

Green light: WKM↔PC has been connected.

Blue light: WKM↔PC communication.

14 Here you can find all the configuration contents in Configuration chapter.

15 Configuration step.

Notices:

- Please power the MC first, then connect your MC to a internet enabled computer by the USB cable before you open the assistant software. You have to register at the first time you use the assistant software. It will auto detect software version when you open the assistant software and prompt message if your version is not the latest one.
- Do not disconnect MC and PC when your are importing or exporting data. You can only import version compatible configuration data.

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Firmware Upgrade

Please strictly follow the operation procedure for firmware upgrade, otherwise WKM might not work properly:

STEP1: Make sure your computer is connected to the Internet.

STEP2: Please close all the other applications during the firmware upgrade, including anti-virus software and firewall.

STEP3: Make sure the power supply is securely connected. DO NOT un-plug the power supply until firmware upgrade has finished.

STEP4: Connect MC to PC with Micro-USB cable, DO NOT break connection until firmware upgrade is finished.

STEP5: Run Software and wait for connection.

STEP6: Select TOOL→Firmware Upgrade.

STEP7: DJI server will check your current firmware version, and get the latest firmware prepared for the unit.

STEP8: If there is a firmware version more up-to-date than your current version, you will be able to click the Upgrade button.

STEP9: Wait until Assistant software reads finished.

STEP10: Click OK and power cycle the unit after at least 5 seconds.

Your unit is up-to-date now.

Notices:

- After firmware upgrade, please re-configure WKM using Assistant software.
- If it is notified that the network or DJI server is busy, please try again later with above procedures.
- If firmware upgrade failed, WKM will enter waiting for firmware upgrade status automatically, please try again with the above procedures.

Product Info

You can check the MC product version via ABOUT → Info. This includes software version, firmware version, IMU version, hardware ID and loader version. S/N is a 32 digits authorization code for unit function activations. We had already filled in the authorization code for your unit after manufacture. You might be asking to fill in the new S/N in the future if you brought new function upgrades. Fill-in the S/N and then click Write button. If you filled in an invalid S/N over 30 times, your MC will be locked and you have to contact our customer support.

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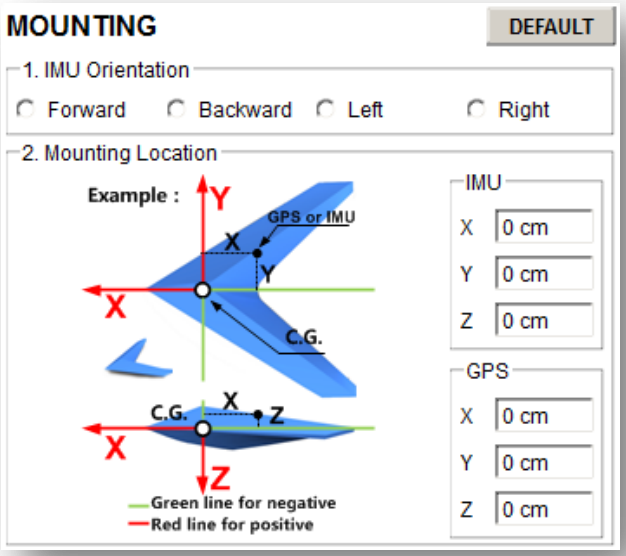
Configuration

1. Mounting



STEP1: IMU Orientation

Select IMU mounting orientation. Orient the IMU such that the arrow marked on the printed surface of the IMU faces the sky and points directly forward, backward, left or right. The sides of the IMU should be precisely parallel to the multi rotor body.

Notices:

Do not mount the IMU upside-down.

STEP2: Mounting Location

Install all payloads that will be used during the flight, including batteries, camera mount and camera. Balance the multi rotor as you would normally, with the center of gravity (C.G.) directly on the center plate. Fill in the distance between body center of IMU/GPS and the C.G. of multi rotor in X, Y & Z axles as showed in the figure.

Notices:

1 You must re-configure if the ALL-UP-WEIGHT had been changed on your multi rotor,

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2 If mounting locations are not accurate enough or the signs are wrong, error on X, Y , Z axles will leads the oscillation of your multi rotor.

3 Make sure to follow the diagram in our assistant software: red is positive, green is negative; unit of measure is CM, NOT INCH.

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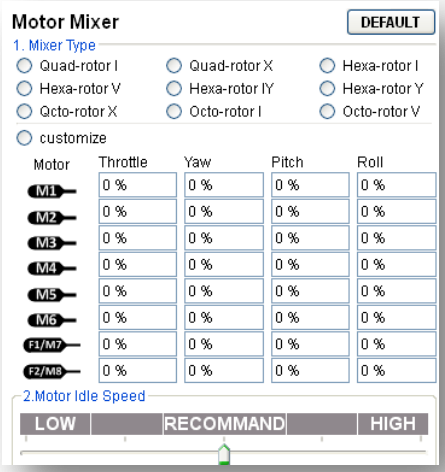
2. Motor Mixer



STEP1: Mixer Type

Set your transmitter into ACROBATIC mode. Then select the right mixer type according to your multi-rotor.

Tips:

- We support nine types of multi-rotors. Please refer to "***Multi-Rotors Supperted***" in "***Appendix***":
- If you want to use gimbal with an Octo-rotor, you have to use S-Bus or PPM receiver, then you can use port T and R for gimbal control. Otherwise, there will be no ports on MC for gimbal.

Notices:

- Do NOT follow instruction from your multi-rotor manufacturer! Make sure the rotation direction of each motor is the same as the way assistant software figure shows. If not, switch any of two wire connetcions of the incorrect motor to change its rotation direction.
- Make sure the type of propeller matches the rotation direction of motor.
- When you set Mixer Type from Octo-rotor to Quad-rotor / Hexa rotor, the gimbal setting will automatically switch to off for safety, which may lead the gimbal to tilt to one side, please turn to the Gimbal section for reconfiguration.

Customize: This segment is reserved only for very special case, such as customized airframe in non-conventional rotor arrangement. In the event, an airworthy multi-rotor craft with such rotor arrangement will require customized setting to meet WKM controller algorithm. Please write to our support department or dealer together with photos of the multi-rotor for assistance.

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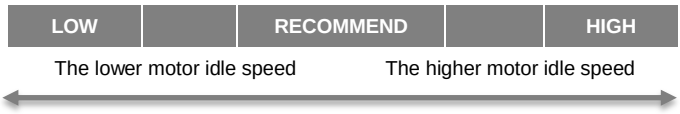
Tips:

- Please refer to "***Customize Motor Mixer***" section in "***Appendix***" for how to customize a central symmetry multi rotor.
- If you customize the motor mixer of a quad-rotor or hexa-rotor, F1 and F2 ports can still be used for gimbal servos control.

STEP2: Motor Idle Speed

Motor Idle Speed is the lowest speed after motor start. Set Motor Idle Speed will affect motor lowest speed after motor start. There are five levels from LOW speed to HIGH speed, and the default is RECOMMEND. You can click and drag cursor to the corresponding level, to change Motor Idle Speed.



Set Motor Idle Speed as LOW, the motor idle speed will be lowest.

Set Motor Idle Speed as HIGH, the motor idle speed will be highest.

RECOMMEND is the advised level.

You can reset the Motor Idle Speed according to the real situation.

Notices:

- For user whose aircraft takes off at lowest throttles position, please set the idle speed at a low level.
- For common users, please set Motor Idle Speed to RECOMMEND or above, since setting idle speed too low may affect motor(s) spool up.

Tips:

- The output pulse width for every grade of Motor Idle Speed is as followed

	LOW		RECOMMEND		HIGH
output pulse width	1144 us	1160 us	1176 us	1192 us	1208 us

- There is relationship between the output pulse width and the max/min pulse width when TX End Point is 100%.

  output pulse width = (max pulse - min pulse) x proportion + min pulse

- You can get the proportion value by computing according to the above formula for a special TX. Use Futaba TX for example. Notice that Futaba TX End Point is 100%.

	LOW		RECOMMEND		HIGH
proportion value	3%	5	7%	9%	11%

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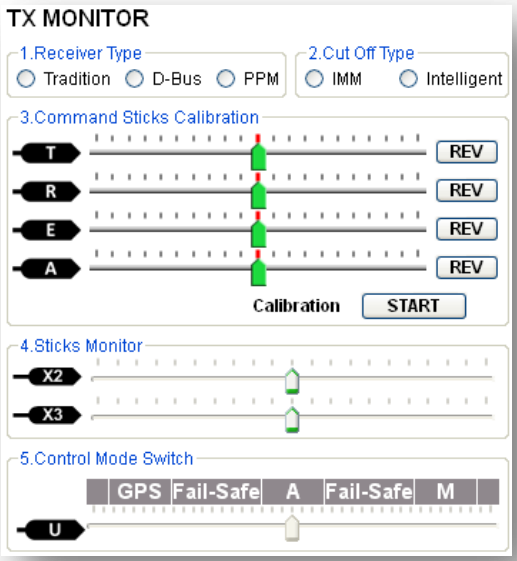
3. Tx Monitor



Notices:

Make sure you have removed all propellers before this step!

STEP1: Receiver Type

Choose the type of your receiver. If you use S-Bus receiver, please choose S-Bus compatible option: D-Bus.

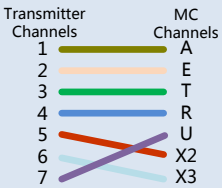
If PPM receiver is used, please choose PPM. Otherwise choose Tradition.

Notices:

Please reboot MC and redo the calibration after you change the setup of your transmitter or change your receiver!

Tips:

- If you use S-Bus/ PPM receiver, the communication of A, E, T, R, U, X2 and X3 channels are all through the D-Bus/PPM channel. Right figure shows the connection of default transmitter channels and MC channels in S-Bus/ PPM receiver (Only first 8 channels of S-Bus receiver are used at the moment). Then the original T and R channels are for Gimbal servo control.



- WKM supports two types of S-Bus receiver; they are R6203SB and R6208SB.

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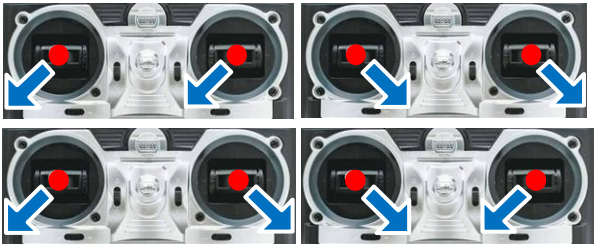
STEP2: Cut Off Type

Please read the introductions of start and stop motor in this step first, and then choose a cut off type.

1 **Start Motor**: When using WKM, pushing throttle stick before takeoff will not start motors. You have to execute any one of following four Combination Stick Commands (CSC) to start motors:



2 **Stop Motor**: We provide two options to stop motors: Immediately, Intelligent.

- Immediately Mode: By using this mode, in any control mode, once motors start and throttle stick is over 10%, motors will stop immediately when throttle stick is back under 10% again. In this case, if you push the throttle stick over 10% in 5 seconds after motors stop, motors will re-start, CSC is no need. If you don't push throttle stick after motors start in three seconds, motors will stop automatically.
- Intelligent Mode: By using this mode, different control mode has different way of stopping motors. In Manual Mode, only executing CSC can stop motors. In Atti. or GPS Atti. Mode, any one of following four cases will stop motors:
  - **a)** You don't push throttle stick after motors start in three seconds;
  - **b)** Executing CSC;
  - **c)** Throttle stick under 10%, and after landing 3 seconds.
  - **d)** The slope angle of multi-rotor is over 70°, and throttle stick under 10%.

Tips (Intelligent Mode):

1 You have to execute CSC to start motors. Push throttle stick only will not start motors.

2 In Atti. / GPS Atti. Mode, it has landing judgment, which will stop motors.

3 Start motors in Atti. / GPS Atti. Mode, you have to execute CSC and then push throttle stick over 10% in 3 seconds, otherwise motors will stop after 3 seconds.

4 During normal flight, only pull throttle stick under 10% will not stop motors in any control mode.

5 For safety reason, when the slope angle of multi-rotor is over 70° during the flight in Atti. / GPS Atti. Mode (may be caused by collision, motor and ESC error or propeller broken down), and throttle stick is under 10%, motors will stop automatically.

6 You can stop motors by executing CSC in any control mode.

Notices:

1. All these two cut off types will work properly only if Tx calibration is correct.

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2. When Tx commands are valid under any control modes, motors will start or stop immediately when you execute CSC. It has nothing to do with current throttle stick position. Please DO NOT executes CSC during flight without any reason.
3. If you choose Immediately mode, you should not pull throttle stick under 10% during flight, because that will stop motors. If you do it accidentally, you should push the throttle stick over 10% in 5 seconds to re-start motors.
4. If you choose Intelligent mode, throttle stick under 10% will trigger landing judgment in any control mode. In this judgment, pitch, roll and yaw controls are denied except throttle, but multi-rotor will still auto level.
5. In any control mode, DO NOT pull throttle stick under 10% during normal flight without any reason.
6. In any auto action caused by failed-safe or low voltage protection （e.g. auto Go Home）, any commands applied to start or stop motors are denied by MC, motors will hold state.

STEP3: Command Sticks Calibration

Slides Moving Definition：

T : Slide left is craft down, slide right is craft up;

R : Slide left is nose left, slide right is nose right;

E : Slide left is craft back, slide right is craft front;

A : Slide left is craft left, slide right is craft right.

STEP1: Set endpoints of all channels to default values (100%) and set all trims and sub-trims of sticks to 0 on your transmitter first. Keep all curves' settings as default since the end-point of transmitter sticks will be recorded here.

STEP2: Click START button, and move all of the sticks throughout their complete range several times.

STEP3: After that, click FINISH button when you finished above procedures.

STEP4: If the moving direction of the slide is opposite to the *Slides Moving Definition*, click the reverse button REV/NORM beside.

Notices:

1. All slides should become when all the sticks are in the middle positions. If slides cannot go back to center points (become), just click FINISH, then slides will be at center automatically. If still not, please reboot MC, and do not apply Tx command during the reboot.
2. CSC may not start motors If trims and sub-trims of sticks are not 0!

STEP4: Sticks Monitor

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This step is optional. X2 and X3 is for remote gain tuning; X3 is also for gimbal pitch control. Setup the channel on your RC correctly.

STEP5: Control Mode Switch

Whichever 2 or 3 positions switch on your transmitter you have selected to use as control mode switch, wire the right channel of receiver to U port of MC. At each switch position, use end-point fine tuning on your transmitter, move the slider of channel U to GPS (GPS Atti Mode), A (Atti. Mode), M (Manual Mode) to turn the corresponding area blue respectively as showed in the figure of last page.

Tips:

- To move the slider is to adjust end-points of the channel selected.
- For 3-position switch, you should assign: Position-1 to Manual Mode; Position-2 to Atti. Mode; Position-3 to GPS Atti. Mode; or reverse the assignment for Position-1 and Position-3.

- For 2-positions switch, you can assign any two of these three control modes as you like.

Move the slider to the range which reads Fail-Safe Mode to turn the area blue, set Fail-Safe output of receiver to input port-U. If you switch off your transmitter now, the U channel slide should move to Fail-Safe Mode and turn the corresponding area to blue. Otherwise please reset the fail-safe. Please refer to your RC manual for the details of fail-safe setup.

Notices:

1. Do NOT set the fail-safe position of throttle under 10% endpoint.
2. MC would not execute Fail-Safe protection if you don't set it properly. You can verify the Fail-Safe settings by shutting down your transmitter, and then you can use the following methods to check whether MC is already in Fail-Safe mode.
   - Check the Assistant Software status bar at the bottom side of the software interface. Control mode will change to Fail-Safe.

   - Check the LED indicator. Read the appendix in this manual for details. LED will give blue blinking if in fail-safe mode.

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4. Autopilot

STEP1: Basic Parameters

Usually, the default parameters are ready to go. However, different multi rotors have different gains because of different size, ESC, motor and propeller. If gain is too large, you will find the multi rotor oscillating in the corresponding direction (About 5~10Hz). If too small, the multi rotor will likely to be hard to control. So you can still setup the basic Gain of Pitch, Roll, Yaw and Vertical manually according to your multi rotor to have a wonderful fly experience. We suggest you to change 10% to 15% of the parameter at a time.

To the gains of Pitch and Roll, if you release the Pitch or Roll stick after command stick, multi-rotor should be back to hovering state. If the reaction of multi-rotor in this procedure is too soft (large delay), please increase the basic gain slowly (10%-15% each time) until vibration emerges after you release the stick. Then decrease the gain a little until vibration just disappears. Now the gain is perfect, but the reaction of the attitude change is slow. You can follow the way introduced at the end of this section to tune the attitude gains.

The way of tuning the Yaw gain is the same as the way of adjusting the Tail Gyro. If you want fast stick reaction speed, increase the gain, otherwise decrease the gain. However, the spin of multi-rotor is produced by the counter torque force, and the magnitude of which is limited. Therefore, large gain will not produce tail vibration like helicopter, but severe reaction at the start or stop of motors, which will affect the stabilization of the other directions.

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You use two methods to judge if the Vertical gain is good enough: 1) The multi-rotor can lock the altitude when the throttle stick is at center position; 2) The change of altitude is small during the flight along a route. You can increase the gain slowly (10% each time) until the vibration emerges along the vertical direction or the reaction of throttle stick is too sensitive, then decrease 20% of the gain. Now it is a suitable Vertical gain.

Attitude gains determine the reaction speed of attitude from command stick, the bigger the value the quicker the reaction. Increase it for sharper and quicker leveling action after command stick released. The control feeling will be stiffness and rigid if the value is too high; and sluggish leveling action and slow braking if too small.

Notices:

- You must click Default button in first setup parameter, and subsequence firmware upgrade.
- The vertical gain will NOT affect the manual mode.

Tips:

- If you are a fresh player, you can tune the basic parameters first as following:
  1. Increase the basic parameters 10% at a time so as to make your multi rotor hover or light oscillate after small angular command input.
  2. Decrease the basic parameters until your multi rotor can just hover, then decrease 10% more.
- If the basic parameters are far away from the proper value, the advanced parameters will not work.
- Here you can make use of remote gain-tuning channels to tune the gains during the flight:
  1. Followed the instructions in “Assembly” R/C System section to connect and setup correctly;
  2. Choose the X2 or X3 channel in Remote Adjust for the gain you want to tune. One channel to one gain.
  3. The range of remote tuning is from half current value to twice current value.
- Usually the Pitch, Roll, Attitude Pitch and Attitude Roll Gains of hexa-rotor are higher than quad-rotor.

STEP2: Advanced Parameters

Usually you can ignore this step. The default values are suitable for most of the conditions, so we do NOT recommend you to change the parameters here. To some special multi rotor, experienced user can adjust the advanced parameters to have a better fly experience.

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STEP3: Enhanced Failed-Safe Methods

Failed-Safe methods include Hover, Go-home, Intelligent Go-home, and Altitude Go-home. Choose one as your failed-safe method, which will be triggered when MC loses the control signal in one of the following situations:

1) Signal lost between transmitter and receiver, e.g. multi-rotor is out of the communication range, or transmitter is down, and so on.

2) One or more connections of A, E, T, R, U channels between MC and receiver loses. If this happens before take-off, motors will not work if you push the throttle stick; if this happens during the flight, LED blue light will flash to warn in addition to the failed-safe method. If Hovering failed-safe method is triggered and U channel is disconnected, multi-rotor will auto land.

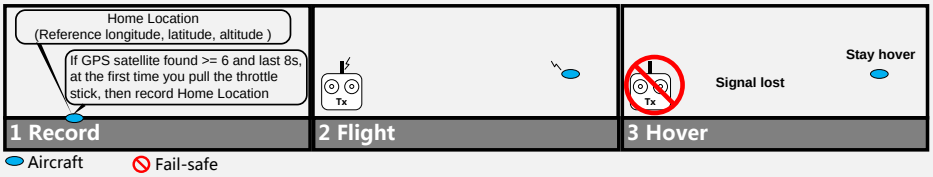
Moreover, you may check the Go-Home Switch item to start go-home (Go-home, Intelligent Go-home, and Altitude Go-home) by a TX switch during flight, with LED purple light flashing instead of blue light flashing.

Multi-rotor position before takeoff, including reference longitude, reference latitude and **reference altitude**, is saved as home point by MC automatically when you push the throttle stick first time after 6 or more GPS satellites are found (blinks once or no blinking) and last 8 seconds at least.

Go-Home Altitude: Determined by the **reference altitude** and the Fail-Safe method chosen. That is, the go-home altitude may be different due to fail-safe method chosen.

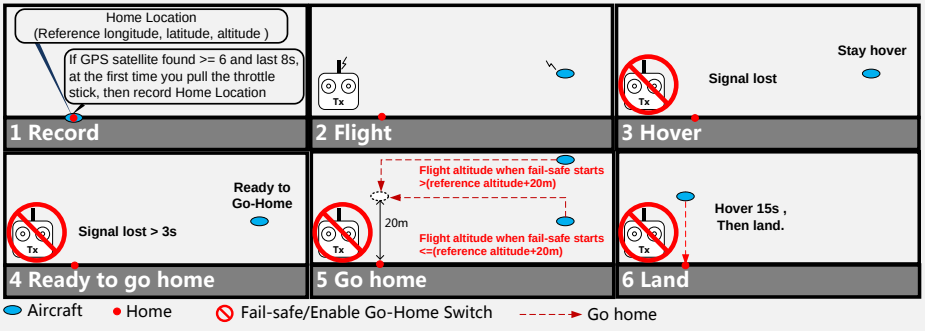
- **Hover**

The aircraft will be hovering when the fail-safe starts.



- **Go-H (Go-home)**

Flight altitude when fail-safe starts>(reference altitude+20m) , go-home altitude = flight altitude when fail-safe starts; Else if<= (reference altitude+20m) , go-home altitude = reference altitude +20m.



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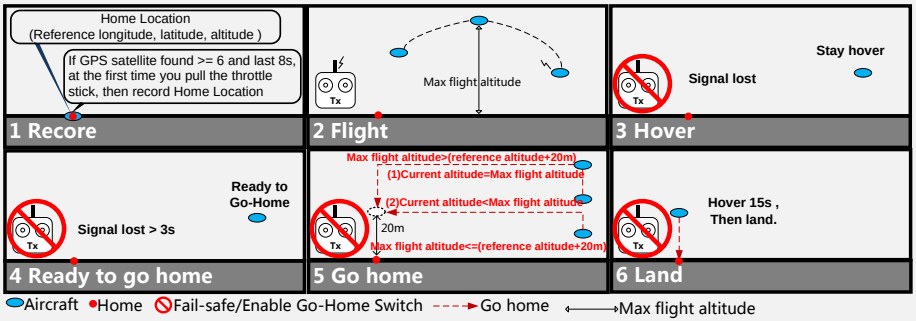
- **Intelligent Go-H (Intelligent go-home)**

Max flight altitude during flight >(reference altitude+20m)，there are two situations:

(1)Current altitude=Max flight altitude, aircraft will go home directly, go-home altitude = max flight altitude;

(2)Current altitude<Max flight altitude, aircraft will increase altitude, and then go home, go-home altitude = max flight altitude;

Else if<= (reference altitude+20m)，go-home altitude = reference altitude +20m.

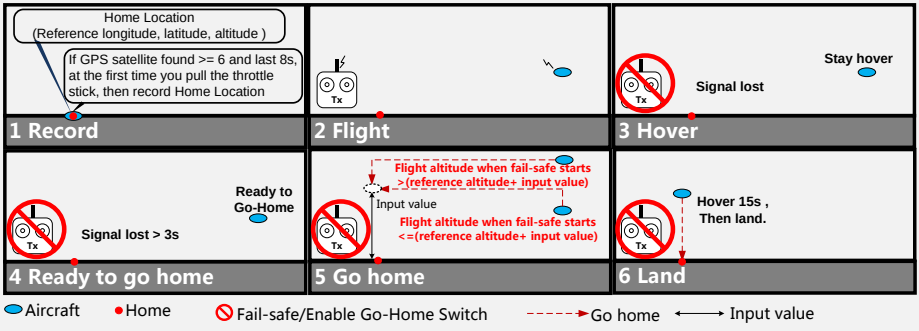


- **Altitude Go-H (Altitude Go-home)**

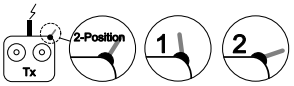
Flight altitude when fail-safe starts>(reference altitude+ input value) ,go-home altitude = flight altitude when fail-safe starts;

Else if <= (reference altitude+ input value)，go-home altitude = reference altitude +input value.

Input value: 10m~100m, the default value is 20m, and has an accuracy of 1m.


Home Location
(Reference longitude, latitude, altitude)
If GPS satellite found >= 6 and last 8s, at the first time you pull the throttle stick, then record Home Location
Stay hover
Signal lost
1 Record
2 Flight
3 Hover
Ready to Go-Home
Signal lost > 3s
Flight altitude when fail-safe starts >(reference altitude+ input value)
Input value
Flight altitude when fail-safe starts <=(reference altitude+ input value)
Hover 15s , Then land.
4 Ready to go home
5 Go home
6 Land
Aircraft
Home
Fail-safe/Enable Go-Home Switch
Go home
Input value

Go-Home Switch： Before using this function, you have to choose a 2-position switch on your transmitter as Go-Home switch. Then connect the right channel of receiver to X3 port of MC.



You should assign: Position-1 to Start; Position-2 to Standby; or reverse the assignment for Position-1 and Position-2. Move the slider of channel X3 to Start and Standby to turn the corresponding area blue respectively.

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Notices:

- Switching from Standby to Start will enable one aircraft go-home during flight. But if the aircraft has been already in fail-safe mode, it will not repeat starting on go home.
- When switch to Manual Mode or Atti. Mode, MC will disengage enhanced failed-safe mode (including two trigger methods, both MC loses the control signal and start Go-Home switch), you can re-gain control of multi-rotor.

Tips:

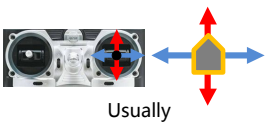
- Use end-point fine tuning on your transmitter to set X3 channel to 30% ~ 100% if assistant does not give correct response to the 2-position switch.
- The following example shows how to enable one Go-home by Tx Switch. Use osition-1 to Start and Position-2 to Standby for example.
  Position -1→ Position -2→ Position -1, if the initial switch position is at Start (Position -1).
  Position -2→ Position -1, if the initial switch position is at Standby (Position -2).
- The home point of the ground station one key go-home is the same as the point set by user in the ground station software.
- If home point is not set by the ground station, the home point of ground station one key go-home function is the point recorded by MC.
- If Go-Home Switch cannot be chosen in the assistant software, that may be X3 channel has been set for remote gain tuning, please cancel it.

STEP4: Intelligent Orientation Control

Forward Direction: Multi-rotor will fly along this direction when you push the elevator stick.

Usually, the forward direction of a flying multi-rotor is the same as the nose direction. By using Intelligent Orientation Control (IOC), wherever nose points, the forward direction has nothing to do with nose direction:

- In course lock flying, the forward direction is the same as a recorded nose direction. See the following figures (Mode 2):



Usually

In course lock

- In home lock flying, the forward direction is the same as the direction from home point to multi-rotor. See the following figures (Mode 2):

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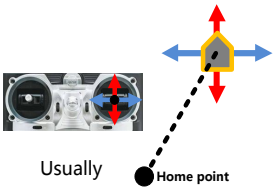
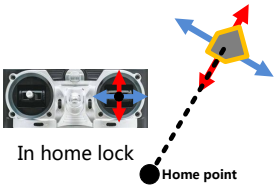
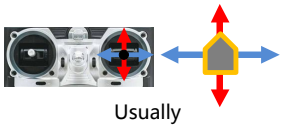
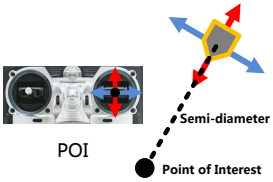




- In POI (**POI, Point Of Interest**) flying, roll channel controls the aircraft cycled flight in a fixed semi-diameter, and pitch channel is for semi-diameter value adjust. See the following chart (Mode 2):





Step1: Before using this function, you have to choose a 2 or 3 positions switch on your transmitter as IOC switch, which is also for recording flight orientation, home position or point of interest in corresponding modes.

Step2: Connect the right channel of receiver to X2 port of MC. You may hit Control 1 to change IOC control mode options. Three IOC control options are available; they are Control 1, Control 2 and Control 3, and every option contains two IOC functions.

Control 1: Home Lock, Course Lock, OFF

Control 2: POI, Course Lock, OFF

Control 3: Home Lock, POI, OFF

Step3: Toggle the switch and move the slider of channel X2 to turn the corresponding area blue respectively.

Tips:

- For 3-position switch (or exchange Position-1 and Position-3):

  Control 1: Position-1 is OFF; Position-2 is Course Lock; Position-3 is Home Lock.

  Control 2: Position-1 is OFF; Position-2 is Course Lock; Position-3 is POI.

  Control 3: Position-1 is OFF; Position-2 is POI; Position-3 is Home Lock.

- For 2-position switch:

  Control 1: Position -1 is OFF; Position-2 is Course Lock. Or Position -1 is OFF; Position-2 is Home Lock.

  Control 2: Position -1 is OFF; Position-2 is Course Lock. Or Position -1 is OFF; Position-2 is POI.

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Control 3: Position -1 is OFF; Position-2 is POI. Or Position -1 is OFF; Position-2 is Home Lock.

- The course, home point and point of interest can be recorded manually by toggling the 3-position switch, and the record content is different when switching occurs in different positions. The following content shows how the MC will record.

  Position-1 ⟷ Position-2: Position-2 is recorded.

  Position-2 ⟷ Position-3: Position-3 is recorded.

  Position-1 ⟷ Position-3: Position-3 is recorded, but Position-2 may also be recorded at the same time. Danger may occur if users are not aware of the change, so it is not recommended to record Position-3 by this way.

- If you use an S-Bus /PPM receiver, default channel connection is shown in *Tx Monitor – Receiver Type* section. Then you only need to assign a 2 or 3-position switch of your transmitter to the 5th channel.
- If the assistant software does not give correct response, please use end-point fine tuning on your transmitter, move the slider of channel X2 to turn the corresponding area blue respectively.

Notices:

When a 2-position switch is used, do NOT set a 2-position switch as:

Control 1: Course Lock and Home Lock at the same time.

Control 2: Course Lock and POI at the same time.

Control 3: POI and Home Lock at the same time.

Course Lock Usage:

During the same flight:

STEP1: Record	STEP2: Open	STEP3: Close	STEP4: Re-open

Nose direction; Forward direction

STEP1: **Record forward direction:** There are two ways: Manually; Automatically. And LED will blink quickly if recording is successful.

a) Automatically: MC will record the current nose direction as forward direction at 30 second after you power on the multi-rotor.

b) Manually: You can slide X2 channel switch between OFF and Course Lock position quickly 3 to 5 times to record current nose direction as new forward direction at any time after you power on multi-rotor 30 seconds.

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STEP2: **Open course lock:** Slide X2 channel switch from OFF to Course Lock position when all the following requirements are met, and LED will blink slowly to indicate the IOC mode.

a) After record the forward direction successfully;

b) MC is in Atti. or GPS Atti. Mode

STEP3: **Close course lock:** Slide X2 channel switch to OFF position to quit course lock.

STEP4: **Re-open course lock:** When all 4 requirements in step2 are met, slide X2 channel switch from OFF to Course Lock position.

Notices:

Pay attention to the following statement, which may also lead the MC to quit course lock:

- Slide U channel switch to Manual Mode position, or close transmitter, or fly in waypoint mode.

Home Lock Usage:

During the same flight:

STEP1: Record	STEP2: Open	STEP3: Close	STEP4: Re-open

Nose direction; Forward direction; ●Home point; -------Over 10m distance

STEP1: **Record home point:** The home point mentioned here is the same home point of enhanced Fail-Safe. There are two ways to record here: Manually; Automatically. And LED will blink quickly if recording is successful.

a) Automatically: Before takeoff, current position of multi-rotor will be saved as home point by MC automatically when you push the throttle stick first time after 6 or more GPS satellites have been found (blinks once or no blinking) for 8 seconds.

b) Manually: When 6 or more GPS satellites are found (blinks once or no blinking), you can slide X2 channel switch between two positions quickly 3 to 5 times to record current position of multi-rotor as new home point.

(1) 3-position switch:

Control 1: slide X2 channel switch between Course Lock and Home Lock position, or OFF and Home Lock (NOT Recommended);

Control 3: POI and Home Lock, or OFF and Home Lock (NOT Recommended).

(2) 2-position switch: slide X2 channel switch between OFF and Home Lock position.

STEP2: **Open home lock:** Slide X2 channel switch from OFF to Home Lock position when all the following requirements are met. LED will blink slowly to indicate the IOC mode.

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a) Home point is recorded successfully;

b) 6 or more GPS satellites are found;

c) In GPS Atti. Mode;

d) Multi-rotor is further than 10m away from home point.

STEP3: **Close home lock:** Slide X2 channel switch to OFF position to quit home lock.

STEP4: **Re-open home lock:** When all 4 requirements in the second step are met, slide X2 channel switch from OFF to Home Lock position to re-open home lock.

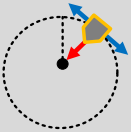
Notices:

Pay attention to the following statement, which may also lead the MC to quit home lock:

- Slide U channel switch to Manual Mode position, or close transmitter, or fly in waypoint mode.
- MC will be in course lock by current forward direction automatically when multi-rotor flies back into 10m range around home point, or MC is in Atti. Mode.

POI (Point Of Interest) Usage:

During the same flight:

STEP1: Record	STEP2: Open	STEP3: Close	STEP4: Re-open
			

Nose direction; Forward direction ; ● Point of interest ; ------Semi-diameter

STEP1: **Record point of interest:**

a) Manually: When 6 or more GPS satellites are found (blinks once or no blinking), you can slide X2 channel switch between two positions quickly 3 to 5 times to record current position of multi-rotor as new point of interest. And LED will blink quickly if recording is successful.

(1) 3-position switch:

Control 2: slide X2 channel switch between Course Lock and POI position,

or between OFF and POI position (NOT Recommended);

Control 3: slide X2 channel switch between OFF and POI position.

(2) 2-position switch: slide X2 channel switch between OFF and POI position.

STEP2: **Open POI** : Slide X2 channel switch from OFF to POI position when all the following requirements are met. After opening POI, the aircraft will rotate slowly until the aircraft nose points to the point of interest, and LED will blink slowly to indicate the IOC mode of MC.

a) Point of interest is recorded successfully;

b) 6 or more GPS satellites are found;

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c) In GPS Atti. Mode;

d) Multi-rotor is further than 5m away from home point and within 500m.

STEP3: **Close POI:** Slide X2 channel switch to OFF position to quit home lock.

STEP4: **Re-open POI**： Slide X2 channel switch from OFF to POI position when all requirements in step2 are met.

Notices:

- Pay attention to the following statement, which may also lead the MC to quit POI:

  (1)Slide U channel switch to Manual Mode or Atti. Mode position, or turn off transmitter, or fly in waypoint mode.

  (2)GPS status is bad, with three blinking.

  (3)Multi-rotor flies back into 5m range around home point or out of 500m.

Tips:

1 LED will blink slowly to indicate the IOC mode only when MC is really fly in course lock or home lock.

2 We suggest that you should know clearly that, by which lock method you are going to fly, and the locked forward direction, home point or point of interest, before you switch on IOC mode during the flight.

3 There is only one home point recorded at any time. This point is the same one used by Go-Home and Landing fail-safe.

4 In Control 1, when flying by home lock, if GPS signal becomes weak, MC will be in course lock by current forward direction automatically.

5 You'd better be near the home point to use home lock, or the point of interest to use POI flight.

6 You'd better use 3-position switch for X2 channel, and you'd better use X2 channel switch to open and close IOC during the flight.

Notices:

1 Before home lock flight, you'd better fly the multi-rotor out of the 10m range around home point, then slide X2 channel switch to Home Lock position to fly in home lock when all the requirements are met. If you have already slide X2 channel switch to Home Lock position when the multi-rotor is still in 10m range around home point, and this is the first time you are going to fly in home lock during the current flight, then if all the requirements are met, MC will change into home lock automatically when multi-rotor flies out the 10m range around home point.

2 When multi-rotor is flying by home lock far away from you and home point, please do not slide X2 channel switch many times quickly so as to avoid the change of home point without your attention.

3 If POI is used in urban area with crowded buildings which may lead to lost signal between

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transmitter and receiver, and then failed-safe method will be triggered.

4 By using a 3-position switch, if you want to record any two of forward direction, home point and point of interest manually, it is recommended to record them separately so as to make sure the record is successful. Please pay attention to following contents for correct record.

- Control 1: Not slide X2 channel switch between OFF and Home Lock position, but only between OFF and Course Lock, or Course Lock and Home Lock position.
- Control 2: Not slide X2 channel switch between OFF and POI position, but only between OFF and Course Lock, or Course Lock and POI position.
- Control 3: Not slide X2 channel switch between OFF and Home Lock position, but only between OFF and POI, or Home Lock and POI position.

5 When you are flying in home lock, if the multi-rotor is back into the 10m range around home point, or you switch into Atti. Mode, MC will fly in course lock by current forward direction automatically. But this forward direction is NOT the recorded forward direction. If you open the course lock now, MC will still fly in course lock by the recorded forward direction.

6 We suggest you to use home lock in a limited area which is 10m away from home point; use POI in a limited area which is 10m away and 500m within from point of interest.

7 If bad GPS quality during flight, the M.C. may not give accurate judgment on radius point of interest.

8 Continuously spinning will cumulate yaw error. LED will blink ○ to indicate huge cumulative yaw error caused by spinning nose continuously in IOC. In this case, you can stop or slow down the spinning, and continue flying after ○ blinking is off so as to have better flight performance.

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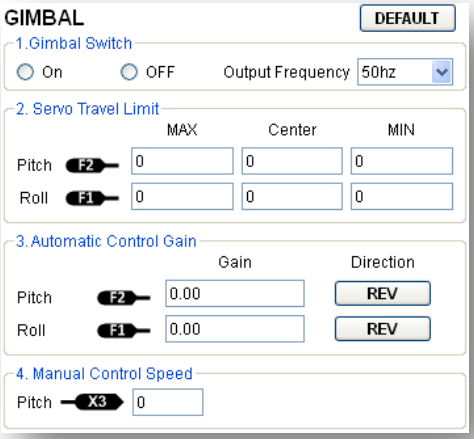
5. Gimbal



STEP1: Gimbal Switch

If you use gimbal, please choose On here, and select an Output Frequency (50Hz/100Hz/200Hz/400Hz). The chosen output frequency is recommended no more than the maximum servo supported frequency.

Notices:

If you open the gimbal control in assistant software during the configuration, please note that there is output from F1 and F2 ports. Now you should not connect these ports to ESCs which is wired with propellers equipped motors.

Tips:

- If you want to use gimbal with an Octo-rotor, you have to use S-Bus or PPM receiver, then you can use port T and R for gimbal control. Otherwise, there will be no ports on MC for gimbal.
- WKM supports servo center 1520us.

STEP2: Servo Travel Limit

Range: -1000 to+1000.

MAX/MIN are servo travel limits; adjust them to avoid mechanical binding; Place your multi rotor on level ground, adjust Center value of Pitch and Roll direction to make the camera mounting frame to your desired angle-to-ground.

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Notices:

- If servo expansion is used, which may enlarge the servo travel limit, make sure to reset your servo travel limit.

STEP3: Automatic Control Gain

Range: 0 to 100.

Adjust the reaction angle of automatic control. The initial value 100 is full angle. The bigger the gain, the bigger the reaction angle. Click REV/NORM, and then you can reverse the feedback control directions.

STEP4: Manual Control Speed

Range: 0 to 100.

You should assign one of the knobs on your transmitter to X3 channel for controlling the Pitch direction (angle) of camera gimbal during flight first. Then adjust the reaction speed of pitch direction manual control; the initial value 100 is full speed.

When X3 is set as stick monitor or for switch go-home, users can not adjust the gimbal pitch by X3 channel, while WKM still provides enhanced stability for gimbal, and the gimbal pitch and roll will return to center.

Notices:

- X3 channel can be used for controlling the Pitch direction while X3 is not for remote gain tuning or Go-Home switch.

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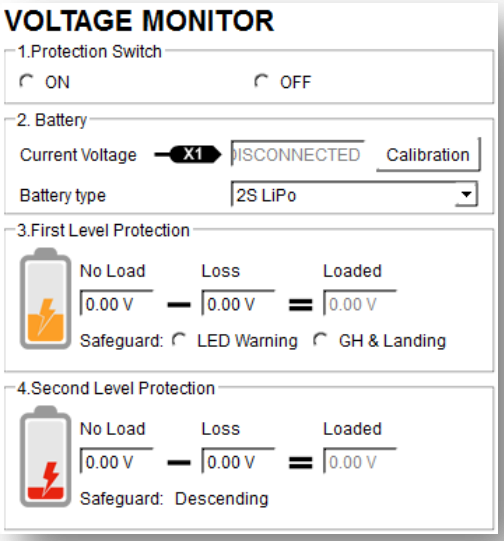
6. Voltage Monitor



STEP1: Protection Switch

In order to prevent your multi-rotor from crash or other harmful consequences caused by low battery voltage, we have designed two levels low voltage protections. You can choose to not to use them, however we strongly recommend to open the protections here!

Notices:

- Make sure two connections between PMU and MC (PW to CAN interface, V-SEN to X1) are correct; otherwise the low voltage protection will not work properly.
- All two level protections have LED warning as default. First level will blink yellow light ● ceaselessly; second level will blink red light ● ceaselessly.
- All two level protections will only have LED warning under Manual Mode, no any automatic actions.
- Low voltage protections are NOT fun! You should land your multi-rotor ASAP in any level of protection to prevent your multi-rotor from crash or other harmful consequences!

STEP2: Battery

Power the MC by a battery and connect the MC with PC, current battery voltage will be displayed in this column.

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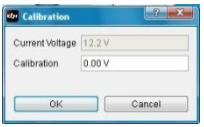
If the battery voltage displayed here is different from the voltage you measure from a voltmeter, you have to calibrate. Click the Calibration, fill the voltage you have just measured in the Calibration column of the dialogue box, and then click OK.



Meanwhile we need you to choose the battery type you are using, so that MC can provide default warning voltages and ranges of warning voltages for you.

STEP3: First Level Protection

No Load (No Load Voltage): Self-defining warning voltage. Needs your input.

Loss (Line Loss Voltage): The battery voltage drop during the flight. Needs your input.

Loaded (Loaded Voltage): The real-time battery voltage during the flight. This is the actual warning voltage monitored by MC. No needs your input, calculated by No Load and Loss.

Tips:

Voltages Magnitude Relation:

- No Load: First level > Second level.
- Loss: First level = Second level.
- Loaded: Calculated, First level > Second level.

Method of Acquiring Line Loss Voltage:

1 Make sure you can fly your multi-rotor normally with a fully charged battery.

2 Use a fully charged battery, switch on the low voltage protections in assistant software, and observe the current voltage. Fill a reasonable warning voltage in the No Load of first protection (We recommend to fill a voltage 1V lower than current voltage and higher than minimum battery voltage rating in). Fill 0V in Loss at the moment.

3 Fly the multi-rotor until the first level protection is triggered, and the yellow light is flashing. Now land your multi-rotor ASAP.

4 Connect the MC to PC, open the assistant and acquire now current voltage. The Loss (Line loss voltage) is the difference between the new current voltage and the first level No Load voltage you filled in.

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Notices:

- If the line loss voltage of a battery is over 0.3V per cell (e.g. 3S battery over 0.9V), it's because the internal resistance of battery is high or the battery is too old, we suggest you to replace it!
- Generally the line loss voltage of different battery is different. For the consideration of safety, you'd better acquire all the line loss voltages of all your battery you are using, and fill the lowest one in the Loss.
- When you change the payload or multi-rotor, you have to get new line loss voltage.
- The line loss voltage will be bigger after many times use, you should get new one after 30 times charging.
- Make sure your ESCs protection voltage is lower than 3.1V (1S), otherwise WKM low voltage protection will not work.

1 Acquire the line loss voltage by the method introduced before first, and fill it in Loss.

2 Fill a reasonable warning voltage in the No Load.

3 Choose a safeguard: 1) LED warning: It is the default safeguard when you switch on the low voltage protection; 2) Go Home and Landing: This safeguard will NOT be triggered when any of the following items is satisfied:

a) Manual or Atti. Mode;

b) GPS signal is not good;

c) The distance between Home Location and multi-rotor is smaller than 25m, and the altitude is smaller than 20m relative to Home Location. Here the generation of Home Location is the same as the way used in Enhanced Failed-safe. Please refer to Enhanced Failed-safe in "Autopilot".

Notices:

- There will be a 4 seconds LED warning before Go Home.
- If you switch to Manual or Atti. Mode during Go Home, you will regain the control. LED warning will be still on, please land ASAP.
- If you switch back into the GPS Mode when you are in first level protection, you will have 15s time to control your multi-rotor, you should land ASAP in this 15s to prevent your multi-rotor from crash or other harmful consequences! After that if the Go Home and landing requirements are satisfied, multi-rotor will Go Home and Landing automatically.
- If you choose LED warning, please land ASAP after LED warning to prevent your multi-rotor from crash or other harmful consequences!
- Compare the Go Home and Landing of low voltage protection and the Go Home and Landing in Enhanced Failed-safe, the generations of Home Location are the same; the Go Home routes are the same; the difference is that there is no hovering before landing in low voltage protection.

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STEP4: Second Level Protection

1 Fill the warning voltage and line loss voltage in No Load and Loss by the method introduced in previous step.

2 When the second level protection is triggered, LED warning will be on. Meanwhile the center point of throttle stick will move up slowly to 90% of endpoint, you should land ASAP to prevent your multi-rotor from crash or other harmful consequences!

3 When the center point is at 90% of endpoint, multi-rotor will still ascend slowly if you continue to pull the throttle stick, and the control of Pitch, Roll and Yaw are the same as before. Please land ASAP to prevent your multi-rotor from crash or other harmful consequences!

Notices:

If your multi-rotor goes into the second level protection during Go Home in first level protection, it will land immediately. If you switch into Manual or Atti. Mode, you will regain the control, and the center point of throttle stick will move up slowly to 90% of endpoint. Please land ASAP to prevent your multi-rotor from crash or other harmful consequences!

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Flight

Digital Compass Calibration

Why calibrate the compass?

Ferromagnetic substances placed on multi rotor or around its working environment will affect the reading of earth magnetic for digital compass, it also reduces the accuracy of the multi rotor control, or even reads incorrect heading. Calibration will eliminate such influences, and ensure MC system performs well in a non-ideal magnetic environment.

When to do it?

- The first time you install WKM on your multi rotor.
- When the multi rotor mechanical setup is changed:
  a) If the GPS/Compass module is re-positioned.
  b) If electronic devices are added/removed/ re-positioned (Main Controller, servos, batteries, etc).
  c) When the mechanical structure of the multi rotor is changed.
- If the flight direction appears to be shifting (meaning the multi rotor doesn't "fly straight").
- The LED indicator often indicates abnormality blinking when the multi rotor yaws. (It is normal for this to happen only occasionally.)

Notices:

- Don't calibrate your compass where there is strong magnetic interference, such as magnetite, car park, and steel reinforcement under the ground.
- DO NOT carry ferromagnetic materials with you during calibration, such as keys or cell phones.
- You don't need to rotate your multi rotor on a precise horizontal or vertical surface, but keep at least 45° difference between horizontal and vertical calibration.
- MC cannot work in the polar circle.

Calibration procedure

STEP1: Enter calibration mode: quickly slide the control mode switch from ***Manual Mode*** to ***GPS Atti. Mode*** for 6 to 10 times, and LED indicator will be constantly on in blue;

STEP2: Calibration in horizontal: rotate you multi rotor along with the horizontal surface until the green light is on constantly, then go to the next step;

STEP3: Calibration in vertical: while green light is constantly on, hold your multi rotor vertically and rotate it along with its vertical axis, keep rotating until the green light is off, meaning the

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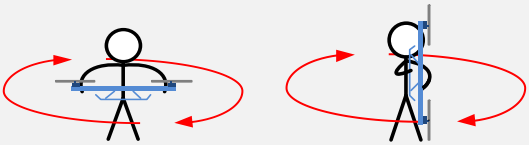
calibration is finished.



STEP4: After you finished the calibration, LED indicator will show whether the calibration was successful or not:

- If white light turns on for 3 seconds, calibration succeeds, calibration mode will auto exit;
- If red light keeps blinking quickly, the calibration has failed. Slide the control mode switch one time to cancel current calibration, and then re-start from step 1 for re-calibration.

Tips:

If you keep having calibration failure, it might suggest that there is very strong magnetic interference around the GPS & Compass module, please avoid flying in this area.

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Test Fly

Before First Flight

Notices:

- Make sure you have assembled your multi rotor correctly.
- Make sure you have done the configuration procedure correctly.
- Any of the following mistakes will lead to dangerous accident, double check all these items:
  - Rotation direction of motor is opposite;
  - Propeller installation mistake;
  - IMU installation mistake;
  - Wrong connection between MC and ESC;
- In Atti and GPS Atti mode, throttle stick center position is for 0m/s on the vertical direction. If you pull the stick to the bottom during the flight, multi-rotor will descend; If you pull the stick to the bottom on the ground, it will cut motors in 3 seconds. However the slow spinning of motors will affect the flight performance, you'd better keep throttle stick position higher than 10% from cut-throttle during the flight! In Manual Mode it will cut motors when pull throttle stick under 10%.
- Make sure switch on the transmitter first, then power on multi-rotor! (Power off multi-rotor first, then switch off the transmitter after landing!)
- Please does the test fly and gain tuning with Atti. Mode in the open air without heavy wind! Please read the first step of *Autopilot* in *Configuration* to learn how to tune gains.

Fly

STEP1: Make sure your batteries are fully charged for your transmitter, MC and all the devices on your multi rotor;

STEP2: Check all connections and wirings, and make sure they are in good condition;

STEP3: Switch on the transmitter first, then power on your multi-rotor!

STEP4: Slide the control mode switch on your transmitter, and make sure it is working properly. Check it with LED indicator to specify the current working mode for MC. See Appendix for details about LED indicator;

STEP5: Switch the system to ***Atti.*** Mode. **Use any safe method to do the following test:** Apply the throttle to 20% slowly in 3 seconds after executing CSC and make sure all the motors are working, and then try to push your sticks lightly in Roll, Pitch and Yaw to feel if your multi rotor moves to the corresponding direction. If not, go back to **Configuration Procedure** correct your settings.

STEP6: Push the throttle stick slowly in 3 seconds after executing CSC until all the rotors are working, and then take-off your multi rotor gently.

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Tips:

After a successful test fly, the preparation before taking off can be simplified: Put your multi rotor on the plane ground, turn on the transmitter first, power on multi rotor, when the red light starts to blink normally, you can take off in Atti. Mode.

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Fly with GPS

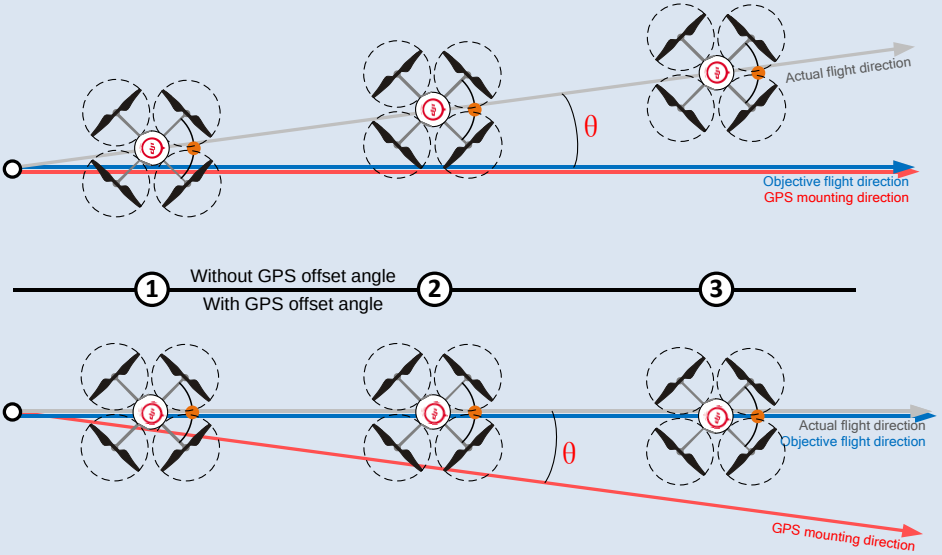
Before Fly with GPS

Notices:

- When system is powered on, you must not move your multi rotor or sticks on transmitter until the system initialization is finished (about 5 second).
- Make sure the GPS signal is good, without red LED blinking. Otherwise multi rotor will drift without stick commands.
- Please avoid using MC system in the following areas, where will GPS signal is most likely blocked:
  - Urban area with crowded buildings
  - Tunnels
  - Under bridges

Tips:

Should you find the multi-rotor does not track straight in forward flight, you might try re-mounting GPS in an offsetting angle as showed in right figure. Θ in the figure is the offsetting angle.



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Appendix

Customize Motor Mixer

For a multi rotor, the roll, pitch, yaw and vertical axes are contributed by the combination of rotors' outputs. This procedure is called Mix Control. The proportion of rotors' outputs is decided by the mechanical structure. Customers can setup the motor output coefficients C in Motor Mixer → Customize so as to realize the Mix Control.

Before customization, you should following knowledge:

1. Motor output = C × Stick position (A or E or T or R).

   Torque produced by motor = Motor output × Force arm of motor (L) = C × Stick position (A or E or T or R) × L
2. The range of C is from -100% to 100%. Maximum C in the same column is 100%. The bigger absolute value of C, The great effect of stick position on motor output. Stick position will not affect motor output when C is 0, which means the motor output is fixed.
3. Each motor has four different output coefficients: C_T, C_Y, C_P, C_R. E.g. C_{Y2} represents coefficient of M2 in yaw control; C_{R5} represents coefficient of M5 in roll control.
4. Motor output is relative to its rotation speed. The bigger output, the faster rotation speed. Negative output does not represent counter rotation, but slower rotation speed. Motor is still spinning if its output is 0.
5. Throttle stick position (T): Pull stick T<0, multi-rotor moves down; Push stuck T>0 multi-rotor moves up;

   Rudder stick position (R): Stick left R<0, multi-rotor nose left; Stick right R>0, multi-rotor nose right;

   Elevator stick position (E): Pull stick E<0 multi-rotor moves backward; Push stuck E>0, multi-rotor moves forward;

   Aileron stick position (A): Stick left A<0, multi-rotor moves left; Stick right A>0, multi-rotor moves right.
6. Multi-rotor should keep balance along all the other axes when moves along one axis:
   - To keep throttle direction balance, sum of all motors' output should be 0 when apply rudder or pitch or roll stick command;
   - To keep yaw direction balance, sum of counter clockwise motors' output should be equal to sum of clockwise motors' output when apply throttle or pitch or roll stick command;
   - To keep pitch direction balance, total torques produced by motors at each side of pitch axis should be the same when apply throttle or rudder or roll stick command;
   - To keep roll direction balance, total torques produced by motors at each side of roll axis

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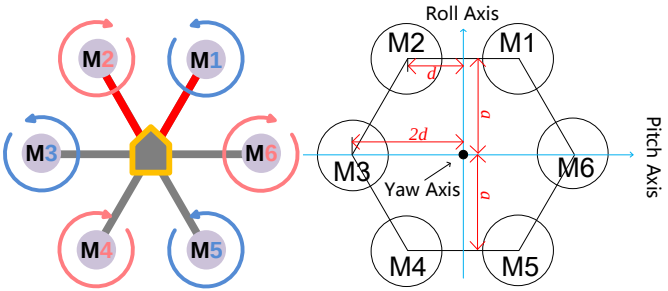
should be the same when apply throttle or rudder or pitch stick command。

7. To pitch or roll control, proportion of coefficients of the motors at the same side of pitch or roll axis should be equal to the proportion of force arms of those motors: $C_m/C_n = L_m/L_n$; Coefficient is 0% if the force arm of that motor is 0.



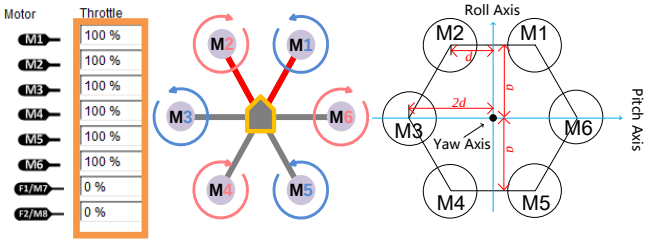
Now we take the Hexa-rotor V as an illustration to introduce how to customize motor mixer.

Throttle

Usually, we want push the throttle stick to ascend the multi-rotor; pull the throttle stick to descend the multi-rotor; put the throttle stick at center point to hover the multi-rotor. We also want multi-rotor to keep balance along all the other axes when apply the throttle stick command:

$$\begin{cases} (C_{T1} + C_{T3} + C_{T5}) \times T = (C_{T2} + C_{T4} + C_{T6}) \times T & \text{(To keep yaw direction balance)} \\ (C_{T1} + C_{T2}) \times T \times a = (C_{T4} + C_{T5}) \times T \times a & \text{(To keep pitch direction balance)} \\ (C_{T2} + C_{T4} + 2C_{T3}) \times T \times d = (C_{T1} + C_{T5} + 2C_{T6}) \times T \times d & \text{(To keep roll direction balance)} \end{cases} \quad 1$$

As we defined before: Pull stick T<0, multi-rotor moves down; Push stuck T>0 multi-rotor moves up, we can choose the following setup:



Now if push the throttle stick, the sum of all motors output ($C_{T1} + C_{T2} + C_{T3} + C_{T4} + C_{T5} + C_{T6}$)×T is positive, then multi-rotor moves up; pull the throttle stick, the sum of all motors output ($C_{T1} + C_{T2} + C_{T3} + C_{T4} + C_{T5} + C_{T6}$)×T is negative, then multi-rotor moves down. And the balance along all the other axes can be derived by substituting the throttle stick command into equations set 1.

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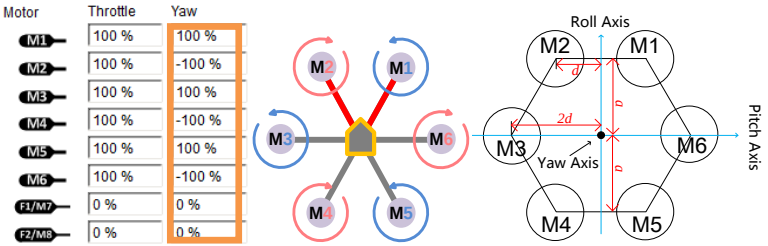
Yaw

The movement about yaw axis is produced by the counter torque force from the rotation of propeller. In our example, M1 M3 M5 produce clockwise torque force; M2 M4 M6 produce counter clockwise torque force. When the hexa-rotor is hovering, all the rotors are spinning at the same angular velocity, which means the clockwise torque force equals to counter clockwise torque force, and this produces exactly 0 angular acceleration about yaw axis. Therefore, when the rotate speed of M1 M3 M5 is larger than M2 M4 M6, hexa-rotor spins clockwise; when the rotate speed of M1 M3 M5 is smaller than M2 M4 M6, hexa-rotor spins counter clockwise. We also want multi-rotor to keep balance along all the other axes when apply the yaw stick command:

$$\begin{cases} \left(C_{R1} + C_{R2} + C_{R3} + C_{R4} + C_{R5} + C_{R6}\right) \times R = 0 \ \text{(To keep throttle direction balance)} \\ \left(C_{R1} + C_{R2}\right) \times R \times a = \left(C_{R4} + C_{R5}\right) \times R \times a \ \text{(To keep pitch direction balance)} \\ \left(C_{R2} + C_{R4} + 2C_{R3}\right) \times R \times d = \left(C_{R1} + C_{R5} + 2C_{R6}\right) \times R \times d \ \text{(To keep roll direction balance)} \end{cases} \quad 2$$

As we defined before: Stick left R<0, multi-rotor nose left; Stick right R>0, multi-rotor nose right, we can choose the following setup:



Now if move the yaw stick right, the sum of M1, M3, M5 output ($C_{R1} + C_{R3} + C_{R5}$) ×R is positive, the sum of M2, M4, M6 output ($C_{R2} + C_{R4} + C_{R6}$) ×R is negative, then the clockwise torque force is larger than counter clockwise torque force, multi-rotor nose right; if move the yaw stick left, the sum of M1, M3, M5 output ($C_{R1} + C_{R3} + C_{R5}$) ×R is negative, the sum of M2, M4, M6 output ($C_{R2} + C_{R4} + C_{R6}$) ×R is positive, then the clockwise torque force is smaller than counter clockwise torque force, multi-rotor nose left. And the balance along all the other axes can be derived by substituting the yaw stick command into equations set 2.

Pitch

The movement about the pitch axis is produced by the differential output of M1+M2 and M4+M5. Since M3 and M6 are on the pitch axis, they do not contribute and torque. You can just keep the rotation speed of M3 and M6 the same as hovering, so C_{P3} and C_{P6} are 0. Increase output of M4, M5 and decrease output of M1, M2, multi-rotor moves forward; decrease output of M4, M5 and increase output of M1, M2, multi-rotor moves

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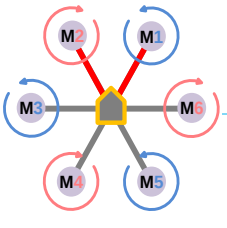
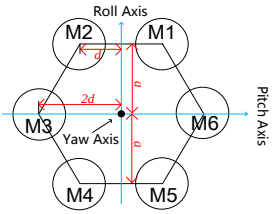
backward. We also want multi-rotor to keep balance along all the other axes when apply the pitch stick command:

$$\begin{cases} \left(C_{E1} + C_{E2} + C_{E3} + C_{E4} + C_{E5} + C_{E6}\right) \times E = 0 \ (\text{To keep throttle direction balance}) \\ \left(C_{E1} + C_{E3} + C_{E5}\right) \times E = \left(C_{E2} + C_{E4} + C_{E6}\right) \times E \ (\text{To keep yaw direction balance}) \\ \left(C_{E2} + C_{E4} + 2C_{E3}\right) \times E \times d = \left(C_{E1} + C_{E5} + 2C_{E6}\right) \times E \times d \ (\text{To keep roll direction balance}) \end{cases} \quad 3$$

Also proportion of coefficients of the motors at the same side of pitch axis should be equal to the proportion of force arms of those motors: $C_{E1} : C_{E2} = C_{E4} : C_{E5} = a : a = 1 : 1$. As we defined before: Pull stick E<0 multi-rotor moves backward; Push stuck E>0, multi-rotor moves forward, we can choose the following setup:

Motor	Throttle	Yaw	Pitch
M1	100 %	100 %	-100 %
M2	100 %	-100 %	-100 %
M3	100 %	100 %	0 %
M4	100 %	-100 %	100 %
M5	100 %	100 %	100 %
M6	100 %	-100 %	0 %
F1/M7	0 %	0 %	0 %
F2/M8	0 %	0 %	0 %





Now if push the pitch stick, the sum of M1, M2 output ($C_{E1} + C_{E2}$) ×E is negative, the sum of M4, M5 output ($C_{E4} + C_{E5}$) ×E is positive, then multi-rotor moves forward; if pull the pitch stick, the sum of M1, M2 output ($C_{E1} + C_{E2}$) ×E is positive, the sum of M4, M5 output ($C_{E4} + C_{E5}$) ×E is negative, then multi-rotor moves backward. And the balance along all the other axes can be derived by substituting the pitch stick command into equations set 3.

Roll

The theory of movement about the roll axis is the same with pitch axis. However there is no motor on the axis in this case, no coefficient is 0%. We also want multi-rotor to keep balance along all the other axes when apply the roll stick command:

$$\begin{cases} \left(C_{A1} + C_{A2} + C_{A3} + C_{A4} + C_{A5} + C_{A6}\right) \times A = 0 \ (\text{To keep throttle direction balance}) \\ \left(C_{A1} + C_{A3} + C_{A5}\right) \times A = \left(C_{A2} + C_{A4} + C_{A6}\right) \times A \ (\text{To keep yaw direction balance}) \\ \left(C_{A1} + C_{A2}\right) \times A \times a = \left(C_{A4} + C_{A5}\right) \times A \times a \ (\text{To keep pitch direction balance}) \end{cases} \quad 4$$

Also proportion of coefficients of the motors at the same side of roll axis should be equal to the proportion of force arms of those motors: $C_{E2} : C_{E3} : C_{E4} = C_{E1} : C_{E6} : C_{E5} = d : 2d : d = 1 : 2 : 1$. As we defined before: Stick left A<0, multi-rotor moves left; Stick right A>0 multi-rotor moves right, we can choose the following setup:

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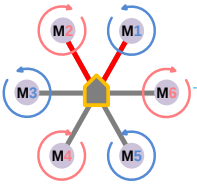
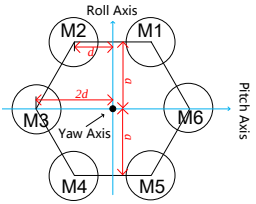
Motor	Throttle	Yaw	Pitch	Roll
M1	100 %	100 %	-100 %	-50 %
M2	100 %	-100 %	-100 %	50 %
M3	100 %	100 %	0 %	100 %
M4	100 %	-100 %	100 %	50 %
M5	100 %	100 %	100 %	-50 %
M6	100 %	-100 %	0 %	-100 %
F1/M7	0 %	0 %	0 %	0 %
F2/M8	0 %	0 %	0 %	0 %





Now if move the roll stick right, the sum of M2, M3, M4 output ($C_{A2} + C_{A4} + 2C_{A3}$) ×A is positive, the sum of M1, M5, M6 output ($C_{A1} + C_{A5} + 2C_{A6}$) ×A is negative, then multi-rotor moves right; if move the roll stick left, the sum of M2, M3, M4 output ($C_{A2} + C_{A4} + 2C_{A3}$) ×A is negative, the sum of M1, M5, M6 output ($C_{A1} + C_{A5} + 2C_{A6}$) ×A is positive, then multi-rotor moves left. And the balance along all the other axes can be derived by substituting the roll stick command into equations set 4.

Summary

1. Once you choose to customize, all coefficients are configurable. However, you only have to setup as many as you need. Leave the rest 0%.
2. Make sure you are clear about the definition of the positive and negative. Make sure you are also clear about the relationship between the output quantity and motor rotation speed.
3. Usually, the coefficients of throttle and yaw are 100% or -100%. The rest of the coefficients should be decided by the proportion of force arms of the motors.
4. The method introduced in this section is only suitable for central symmetry multi rotor.

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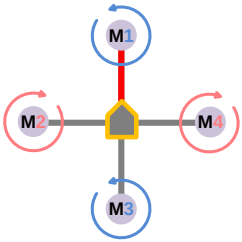
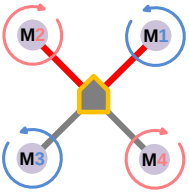
Multi-Rotors Supported

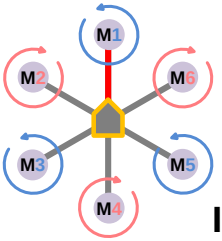
To coaxial propellers: Blue propeller is at Top; Red propeller is at Bottom. Otherwise all propellers are at top.



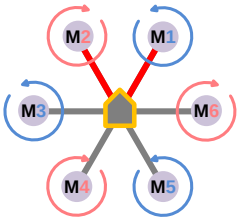
I4



X4



I6



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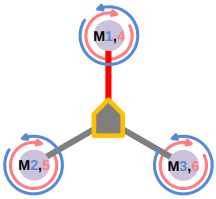
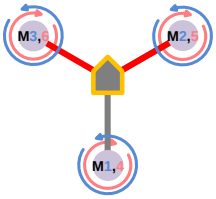
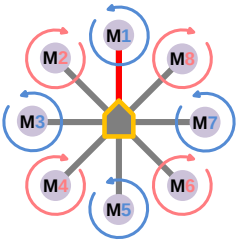


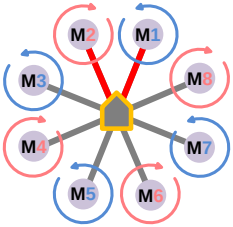
IY6



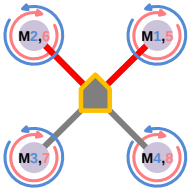
Y6



I8



V8



X8

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Port Description

Main Controller

A	For roll control (left/right)		
E	For pitch control (front/back)		
T	For throttle control	Or to gimbal roll servo	
R	For rudder control	Or to gimbal pitch servo	
U	For Control Mode Switch		
X1	For voltage monitor (Connect with PMU V-SEN port)		
X2	For D-Bus (S-Bus compatible)	Or for gain tuning	Or for IOC switch
X3	For gimbal pitch control	Or for gain tuning	Or for switch go-home
M6	To #6 rotor		
M5	To #5 rotor		
M4	To #4 rotor		
M3	To #3 rotor		
M2	To #2 rotor		
M1	To #1 rotor		
F2	To gimbal pitch servo	Or to #8 rotor	
F1	To gimbal roll servo	Or to #7 rotor	
	Micro-B USB port: PC connection for configuration and firmware upgrades.		
	CAN-Bus port: MC uses CAN-Bus to power and communicate with other WKM modules.		

(In three-pin ports, pins near the nicks are signal pins.)

Power Management Unit

V-SEN For monitoring battery voltage and supplying power to receiver and other electronic devices. (Connect with MC X1 port)

- White wire (signal wire) output: ±3.3V
- Red wire (power wire) output: 3A@5V

PW For supplying power to WKM system.

- Output: Max 2A@12.6V

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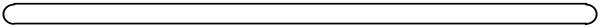
Light Description

Flight States

	Manual Mode	Atti. Mode	GPS Atti. Mode	IOC	Tx Signal Lost
GPS satellites < 5					
GPS satellites < 6					
GPS satellites < 7					
Attitude & GPS good					
Attitude status fair					
Attitude status bad					
IMU data Lost					

- Sparking indications of , , are: **Single spark**, all the sticks return to center, multi rotor hovering; **Double spark**, stick(s) not at center, speed command is not zero.)
- Fast blinking: Record forward direction or home point successfully.

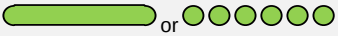
Compass Calibration

Begin horizontal calibration	
Begin vertical calibration	
Calibration finished	
Calibration or others error	

Low Voltage Warning

First lever protection	
Second lever protection	

MC LED

MC is functioning well.	
Boot loader mode, MC is waiting for firmware upgrading.	
Firmware upgrading is finish. MC is waiting for reboot.	
Error occurs during firmware upgrading, MC reboot is required.	

PMU LED

PMU connection is correct.	
Connection between PMU and battery is wrong (polarity error).	

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Specifications

General		
Built-In Functions	● Three Modes Autopilot ● PPM Receiver Supported ● 2-axle Gimbal Support ● Enhanced Fail Safe	● S-Bus Receiver Supported ● Intelligent Orientation Control ● Multi Output Frequency Supported ● Low Voltage Protection
Peripheral		
Supported Multi-rotor	● Quad-rotor: I4, X4; ● Hexa-rotor: I6, X6, Y6, IY6; ● Octo-rotor: X8, I8, V8.	
Supported ESC output	400Hz refresh frequency.	
Recommended Transmitter	PCM or 2.4GHz with minimum 7 channels and failed-safe function available on all channels.	
Recommended Battery	2S ~ 6S LiPo	
Assistant Software System Requirement	Windows XP SP3 / 7	
Electrical & Mechanical		
Power Consumption	MAX 5W (0.9A@5V, 0.7A@5.8V, 0.5A@7.4V, 0.4A@8V)	
Operating Temperature	-5°C to +60°C	
Total Weight	<= 118g (overall)	
Dimensions	● MC: 51.2mm x 38.0mm x 15.3mm ● IMU: 41.4mm x 31.1mm x 27.8mm ● GPS & Compass: 50mm (diameter) x 9mm ● LED Indicator: 25mm x 25mm x 7mm ● PMU: 39.5mm×27.5mm×9.7mm	
Flight Performance (can be effected by mechanical performance and payloads)		
Hovering Accuracy (GPS Mode)	● Vertical: ± 0.5m ● Horizontal: ± 2m	
Maximum Wind Resistance	<8m/s (17.9mph / 28.8km/h)	
Max Yaw Angular Velocity	150deg/s	
Max Tilt Angle	35 °	
Ascent / Descent	±6m/s	

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